Appendix 5. The Park Lane Light Rail Corridor Serving Dallas

Executive summary

Working Paper 1 (Subtask 1d, November 25, 1998) develops a theoretical and measurement framework within which the Mogridge-Lewis Convergence Hypothesis (MLC) can be employed in measuring the savings in highway delay attributable to transit and its equilibrating effect on the level of service in the corridor.

The framework also provides an MLC-based approach to making repeated measures of transit-induced savings in corridor delay *without* the need for repeated MLC surveys. The approach rests on the theoretical proposition, proven in Working Paper 1, that a stable and measurable relationship exists between roadway traffic growth over time and the inter-modal (highway-transit) equilibrium dynamics that give rise to delay savings in a congested corridor. In the absence of major changes in the level of highway supply or transit service in the corridor, this measured relationship, or model, provides a formula-based performance measurement system in lieu of a survey-based approach. In addition to the obvious cost advantages, this approach provides FTA with (i) an efficient means of measuring and comparing transit performance in strategic corridors; and (ii) a consistent performance assessment tool for transfer to MPOs throughout the country.

Purpose and Method

This Working Paper presents a case study of the methodology developed in Subtask 1c in application to the Park Lane-Dallas corridor. The methodology consists of calibrating the MLC-traffic model with survey data. The model is then used to quantify delay savings attributable to light rail at present, and at alternative roadway traffic volumes (each for different user categories).

The study consists of four main steps:

1. Collecting highway travel data (traffic volume, distance, travel time, and vehicle occupancy in the corridor); and light rail ridership data along the corridor;
2. Conducting door-to-door travel time surveys and deriving the inter-modal convergence;
3. Estimating the “with transit” and “without transit” model and related curves and estimating the hours of delay saved due to transit; and
4. Quantifying delay savings by user category, namely, (i) light rail riders (“market” benefits); (ii) common segment users (“club” benefits); and, (iii) parallel highway users (“spillover” benefits).

The Park Lane-Dallas corridor was selected to measure the performance of the light rail system connecting several residential areas with the Central Business District of Dallas, Texas. MLC theory predicts that the improved transit system will attract modal explorers, reduce congestion, and improve roadway travel times. As a result, we would expect to see improvements in *both* highway and transit door-to-door travel times

Principal Findings

The case study finds that based on the MLC model calibrated with 1999 survey data, the magnitude of peak-period delay savings per trip due to transit is about 3.54 minutes per door-to-door trip (about 18 seconds per mile). These savings amount to about 8 percent of total door-to-door journey times and align with reasoned expectations.

HLB estimated the hours of delay savings for three different user groups: Light rail riders (market benefits), users of the US-75 common segment (club benefits), and users of parallel highways (spillover benefits). Table A 5.1 presents the estimated delay savings by category of user. Based on an assumed value of peak travel time of $15 per hour and an average of 250 working days per year, Table A 5.1 indicates aggregate peak delay savings due to transit of $36.8 million for 1999. The savings can be translated to $2.8 million per rail mile.

Table A 5.1 Benefits Summary for the Park Lane-Dallas Corridor

	Daily Savings		Yearly Savings
Benefit Category	In Hours	In Dollars	In Dollars
Market	4,311	64,672	16,167,962
Club	1,990	29,855	7,463,708
Spillover	3,532	52,984	13,246,016
Total	9,834	147,511	36,877,686

The summary table shows that 44% of the savings are market savings. These results illustrate the relative high ridership and the high reliability on light rail in the corridor.

Figure A 5.1 displays the "with-" and "without transit" curves using 1999 convergence data. The vertical difference between the "with-" and "without transit" curves represents the delay savings due to transit at different volumes of US-75 traffic. The curves indicate that in the absence of major infrastructure improvements or radical traffic growth, the performance metric will remain stable.

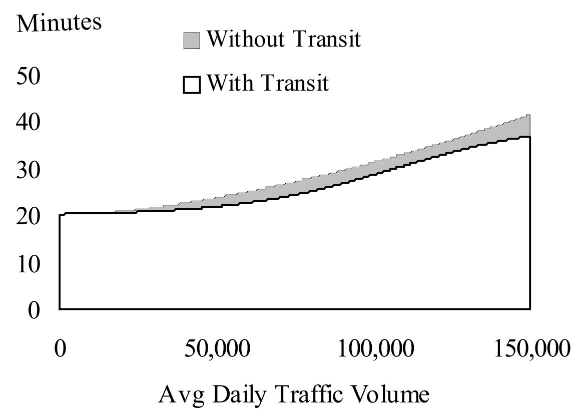


Figure A 5.1 Illustration of the "With-" and "Without Transit" curves for the Park Lane - Dallas Corridor

Introduction

This report presents the results for the Park Lane-Dallas corridor case study as part of Streamlined Strategic Corridor Travel Time Management study. The purpose of the study is to use the convergence measurement technique to derive a repeatable performance measurement for rail transit in congested corridors. This case study measures the performance of Dallas's light rail system using the methodology developed in Subtask 1c. The methodology consists of calibrating the Mogridge-Lewis Convergence Hypothesis (MLC) model with survey data and using the model to quantify delay savings attributable to transit at different roadway traffic volumes. The savings are estimated for three different user categories using highway traffic data and light rail ridership in the corridor.

Study Methodology

The study methodology consists of four main steps:

1. Collecting highway travel data (traffic volume, distance, travel time, and vehicle occupancy in the corridor); and light rail ridership data along the corridor;
2. Conducting door-to-door travel time surveys and deriving the inter-modal convergence;
3. Estimating the "with transit" and "without transit" model and related curves and estimating the hours of delay saved due to transit; and
4. Quantifying delay savings by user category, namely, (i) light rail riders ("market" benefits); (ii) common segment users ("club" benefits); and, (iii) parallel highway users ("spillover" benefits).

During the first step, HLB collected HPMS data, local arterials traffic data, and light rail ridership data from The City of Dallas, Transportation Planning Department (the local MPO) and Dallas Area Rapid Transit-DART (the local transit authority). The data were used to estimate the model parameters.

For the second step, data was collected on site by a survey team. A corridor, as defined in this study, is a principal transportation artery into the central business district. Multiple transportation services are available to commuters who use this artery. Additionally, during the peak period a large number of commuters utilize this route in their door-to-door commute.

A statistical sample of trips was generated in the corridor by identifying random trip end point in the zones at either end of the corridor and joining them so that trips alternated between zones. These zones are catchment zones where travelers converge or diverge from either the transit station or the principal highway route. In this study these zones are defined as the access segment and the component of the corridor common to all trips for a given mode, regardless of trip end location, is defined as the common segment.

Survey crews were instructed to follow specific routes that consisted of an access segment—dependent on the catchment zone considered for the trip—and a common segment. The data collected include start times and arrival times for each segment, by mode, congestion level, seating availability, weather, road conditions, and travel costs for each segment.

Data were collected over a period of three consecutive days (Tuesday to Thursday) during the third week of September 1999. The days of the week were sampled to eliminate fluctuations in traffic patterns and volumes due to the day of week effects. Trips were validated to minimize the effects of unusual or circumstantial conditions. Sixty valid trips were selected to ensure a statistically adequate sample size. The study employed the maps and routes connecting several zones within a residential area to several points within Dallas's central business district.

Step three consisted of estimating the "with transit" curve based on the traffic volume and the door-to-door travel time. Using the model developed in Subtask 1c, HLB derived the "without transit" curve and estimated the hours of delay saved due to transit. This performance metric is defined as the vertical difference between the two curves.

In step four, the hours of delay saved due to transit are aggregated into three user categories. Savings by common highway-segment users are estimated using the traffic volume on the segment. Savings by light rail riders are estimated using the ridership data for each station along the corridor. Savings by parallel highway users are estimated using traffic volume on parallel highways and arterials within the corridor. The magnitude of the savings decreases as the distance between the common segment and the arterial increases.

Plan of the Report

This report presents the results from the Park Lane-Dallas corridor case study. Following this introduction, Chapter 2 presents an overview of the model and methodology to estimate the delay saving. Chapter 3 displays the corridor characteristics and a description of the principal modes of transportation within the corridor. Chapter 4 presents the results from the 1999 door-to-door travel survey and shows the model estimation results. The chapter estimates the hours of delay saved due to transit per person per day, and provides a monetary value of the delay saved for three user categories. Appendices provide maps of the residential area and the central business district as well as supporting data and supplementary results on the survey findings by route.

Methodolgy and Model Overview

The methodology consists of four steps:

1. Estimating the Corridor Performance Baseline
2. Estimating the Corridor Performance in the Absence of transit
3. Extrapolating Delay Savings Due to Transit
4. Estimation of Corridor Performance without Re-calibration

Estimating the Corridor Performance Baseline

<u>The Model</u> This model establishes a functional relationship between the person trip volume – all modes—and the average door-to-door travel time by auto in the corridor.

The door to door travel time by auto can be determined using a logistic function which calculates the door to door travel time in terms of travel time at free flow speed, trip time by high capacity rail mode, and the volume of trips in the corridor for all modes. The door-to-door travel time can be estimated as follows:

4. $$\mathbf{T = (T_c - T_{ff}) / (1 + e^{-(\delta + \varepsilon V1)}) \quad + T_{ff}} \qquad \mathbf{(1)}$$

Where T_{a1} is auto trip time,

Tc is trip time by high-capacity rail mode

T_{ff} is auto trip time at free-flow speed,

V is person trip volume in the corridor by auto, and

δ, ε are model parameters

Equation 1 implies that the door-to-door auto trip time is equal to the trip time at free-flow speed plus a delay that depends on transit travel time and the person trip volume in the corridor.

In other words, when the highway volume is close to zero, travel time is equal to travel time at free flow speed.($T = T_{ff}$). As the volume increases, the travel time is equal to T_{ff} plus a delay due to the high volume, but adjusted to the travel time by high capacity transit. That is the high capacity transit alleviates some of the highway trip delay as some trips shift to transit.

Equation 1 is transformed into a linear functional form before the parameters δ and ε can be estimated, the transformed equation will be:

$$\mathbf{U = \delta + \varepsilon V_1} \qquad \mathbf{(2)}$$

Where $U = \ln [(T_c - T_{ff}) / (T - T_{ff}) - 1]$

Equation 2 is estimated using Ordinary Least Squares regression.

Data The data required for the estimation of the above equations are:

- Person trip volume on the highway that can be calculated by dividing the traffic volume by the average vehicle occupancy (auto and buses). This data are available through HPMS database and MPO's traffic data.
- Free flow trip time is a constant.
- High capacity trip time is a constant.

The parameters δ and ε do not have to be re-estimated each year, they are both specific to the corridor and are relatively stable over the years. So periodically, the person trips volume can be inserted into Equation 1 to estimate the door to door travel time by auto.

Estimating the Corridor Performance in the Absence of transit

The Model This model represents the concept to quantify the role of transit in congestion management. In the absence of transit, the travel time Ta is estimated as:

$$\mathbf{T_a = T_{ff} \ * \ (1 + A (V^*)^{\beta})} \qquad \mathbf{(3)}$$

Where T_a is the door to door travel time in the absence of transit,

T_{ff} is the trip travel time at free-flow speed,

V* is the volume of person trips by auto in the absence of transit,

A is a scalar, and β is a parameter.

Equation 3 implies that the door-to-door travel time in the absence of transit depends on the travel time at free-flow speed and the level of congestion on the road in the absence of transit.

The volume of person trips by auto in the absence of transit, however, depends on several factors:

- The existing auto and bus person trips on the highway.
- The percentage of person transit trips shifting to auto
- The percentage of person transit trips shifting to bus
- The number of additional cars in the highway
- The number of additional buses in the highway

The occupancy per vehicle in the absence of transit The volume of person trips by auto, in the absence of transit, can then be estimated as:

$$\mathbf{V^* = V_1 + \alpha_1 V_c + \alpha_2 V_b} \qquad \mathbf{(4)}$$

Where V_1 is the existing auto volume,

V_c is the transit person trips diverted to cars,

V_b is the transit person trips diverted to buses, and

α_1, α_2 are the coefficients that incorporate the passenger car equivalent factor, and the occupancy per vehicle (cars and buses).

The trips diverted to cars and buses depend mainly on the degree of convergence in the corridor. This degree of convergence reflects the transit user behavior and the composition of these users. The transit users can be divided into 3 categories:

Type 1: "Explorers" who are casual switchers and who will divert to Single Occupancy Vehicles in the absence of transit.

Type 2: Commuters with low elasticity of demand with respect to generalized cost and who will divert to use the bus or carpool.

Type 3: Commuters with high elasticity of demand with respect to generalized cost and who will forgoes the trip.

The higher the degree of convergence (auto and rail door to door travel times are very close), the higher the shift of transit riders to cars and buses. Therefore, higher degree of convergence will lead to higher delay, which translates into higher savings due to transit.

In words, Equation 3 shows that in the absence of transit and in the case of a high degree of convergence, the person trip volume is very high which translates into a high trip time (excessive delay). The relationship between trip time and person trip volume can be expressed as a convex curve (as the volume increases, travel time increases at an increasing rate). Figure A 5.2 illustrates the relationship between the volume and travel time both in the presence and in the absence of transit.

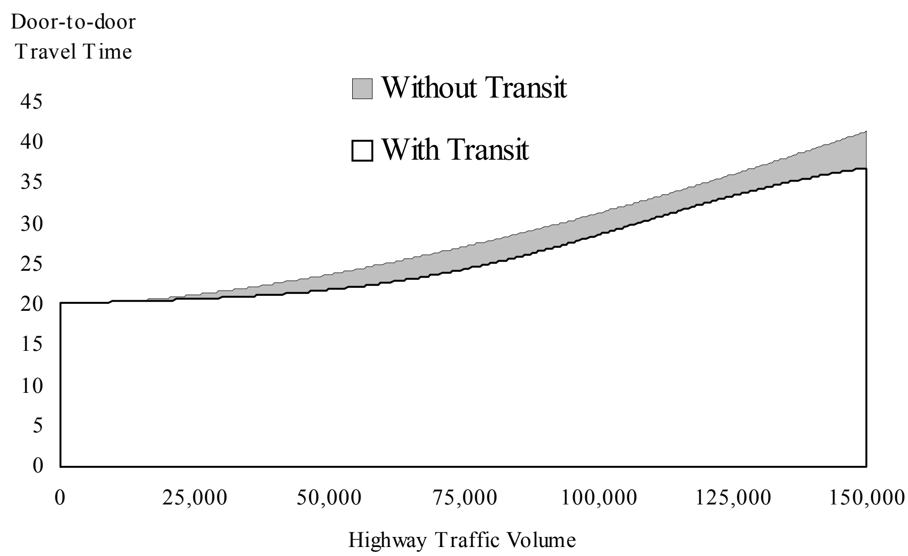


Figure A 5.2 Travel Time With and Without Transit.

Data The data required to populate this model consist of:

- Highway person trip volume (used in the previous model)
- Transit ridership data
- Fleet composition (cars and buses percentages out of the total traffic)
- Cars and buses vehicle occupancy
- Passenger car equivalent factor
- Degree of convergence to determine the percentage person trips shifting to cars and buses
- Free-flow travel time which is a constant

Equation 3 is specific to the corridor and do not need to be estimated each year. It will only be necessary to re-estimate them with an updated degree of convergence if a major change is made to the transit level of service or the highway structure.

Extrapolating Delay Savings Due to Transit

While the MLC hypothesis proves to be valid during the peak period only, the delay savings due to transit can be estimated during off-peak as well. This metric can be estimated as the vertical difference between the "without transit" curve and the "with transit" curve. That is at a specific person trip volume, the difference in travel times between the two cases can be defined as "the hours of delay saved due to transit".

The estimated hours of delay savings due to transit are an aggregation of three different user savings: savings by light rail riders (market benefits), savings by highway users (club benefits), and savings by users of parallel highways (spillover benefits).

The market benefits are estimated based on delay saved (which depends on the distance traveled) for each rider within the common segment.

The club benefits are estimated based on the volume on the common segment using origin-destination table and the daily trip distribution.

The spillover benefits are estimated based on the savings per mile, traffic volume, and the distance traveled on segments parallel to the common segment. The spillover benefits are calculated by multiplying the traffic volume with a percentage of the delay savings. This percentage decreases as the distance between the common segment and the parallel highway increases.

Estimation of Corridor Performance without Re-calibration

The framework presented above provides an MLC-based approach to making repeated measures of transit-induced savings in corridor delay *without* the need for repeated MLC surveys. The approach rests on the theoretical proposition, that a stable and measurable relationship exists between roadway traffic growth over time and the inter-modal (highway-transit) equilibrium dynamics that give rise to delay savings in a congested corridor. In the absence of major changes in the level of highway supply or transit service in the corridor, this measured relationship, or model, provides a formula-based performance measurement system in lieu of a survey-based approach. In addition to the obvious cost advantages, this approach provides FTA with (i) an efficient means of measuring and comparing transit performance in strategic corridors; and (ii) a consistent performance assessment tool for transfer to MPOs throughout the country.

Corridor Overview

The Park Lane-Dallas corridor is about 13.0 miles in length and connects the residential area around I-75 and Northwest Parkway to the central business district, downtown Dallas. The residential catchment zone is centered around Park Lane Light Rail Station. Trip end points within the residential zone are no more than a 15-minute drive to the station. The downtown Dallas CBD zone, centered around West End Light Rail station, extends for a radius of .6 miles. App. Annex A1 provides maps of the residential and business district zones considered in this study. The Park Lane-Dallas light rail line (Red Line) is part of the line connecting Park Lane to Westmoreland, southwest of Dallas.

Principal Travel Modes

The “principal travel mode” is defined as the mode used during the common segment of each individual trip. The main transportation modes serving the Park Lane-Dallas Corridor are automobile and light rail. Automobile routes can be broken into three distinct sections:

1. The route between the residential point and the intersection of US-75 and Northwest Parkway (Access1);
2. The route from the intersection of US-75 and Northwest Parkway to Alamo street (Common Segment); and
3. The route from the intersection Alamo Street and McKinney to the CBD destination point (Access2).

For a morning rush hour trip, survey drivers followed Access1 to the common segment. The common segment route originated at the intersection of US-75 and Northwest Parkway close to Park Lane Station area. Drivers followed US-750 to Knox Street, then drive south on Cole Street to the intersection of McKinney and Alamo Street. From the end of the common segment, survey drivers followed Access2 to the downtown points, at which time they parked at the closest parking lot and proceeded on foot to the end point. The evening rush hour trip covered the same progression in the opposite direction.

The routes for the light rail mode riders can be broken into three distinct sections

1. The route between the residential point and the Park Lane Station (Access1);
2. The route between the Park Lane Station and the West End Station (Common Segment); and
3. The route between the West End Station and the CBD point (Access2).

For a morning rush hour trip, survey crews drove Access1 to the Park Lane Station parking lot and walked from the lot to the light rail station. The route taken for the common segment consisted of a light rail trip that begins at the Park Lane Station and continues to the West End Station Station. From the end of the common segment, the surveyor walked Access2 to the downtown points. The evening rush hour trip covered the same progression in the opposite direction. On average, trains run every 8 to 12 minutes during peak hours. Table A 5.2 displays some of the principal performance and service characteristics of the corridor. Figure A 5.3 shows the Park Lane-Dallas corridor and the main highways and arterials in the area.

Table A 5.2 Performance and Service Characteristics for Park Lane-Dallas Corridor

	Automobile	Light Rail
Number of stops	N/A	6
Number of Streets and Highways	3	N/A
Tolls/Fares for a one way (in dollars)	$0.00	$1.00

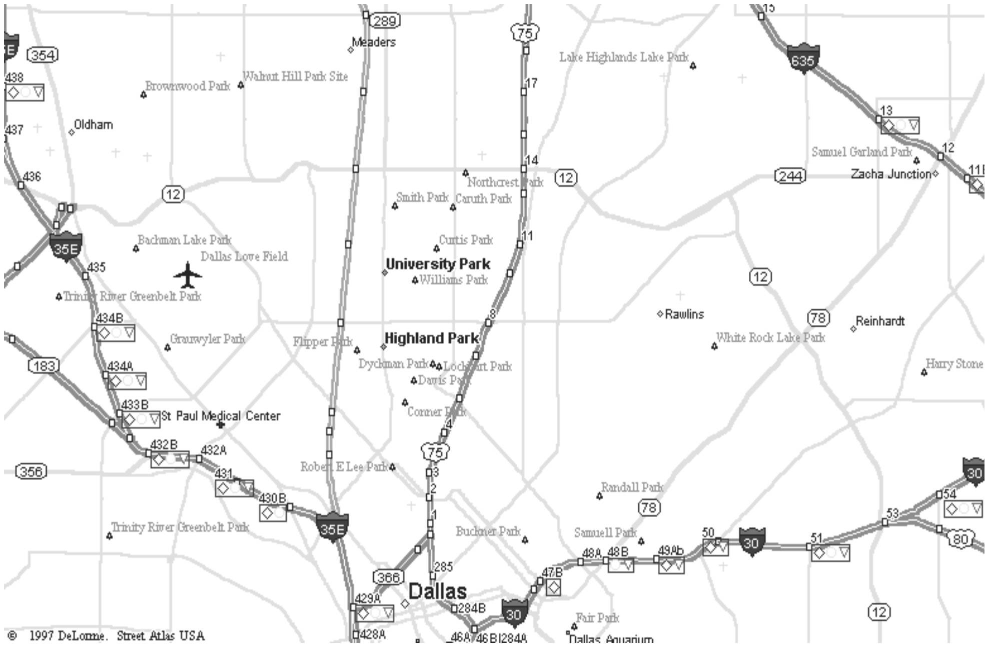


Figure A 5.3 Map of the Park Lane--Dallas Corridor

Principal findings

This chapter starts by presenting the results from the door-to-door travel survey conducted during the third week of September 1999. The travel survey data are used to derive the inter-modal convergence level in the Park Lane-Dallas corridor. The chapter then presents the estimation of the hours of delay saved due to transit for different user categories.

The Convergence Level

The starting point to estimate the "without transit" curve is to determine the convergence level based on the key findings from the 1999 door to door travel data.

The door-to-door travel survey for the Park Lane-Dallas Corridor found that:

Average door-to-door travel times for auto and metro rail, are similar, 52.36 minutes by light rail versus 46.5 minutes by auto (Table A 5.3).

Travel time reliability, as represented by the standard deviation of average travel time is 4.28 for light rail mode and 7.06 for the auto mode (Table A 5.3).

Commuters experienced similar travel times in the morning and in the evening reflecting the similar traffic dynamics of the inbound peak flow versus the outbound peak flow in the corridor (Table A 5.4).

Statistical analysis shows that the mean trip time by auto was at most 9 minutes longer with 95% confidence (Table A 5.5).

The common segment travel time was slightly higher for the light rail mode than for the transit mode, 21.47 minutes versus 19.4 minutes. The slight difference of 2.03 minutes between the two modes is due to the fewer stops of the light rail (6 stops) while the common segment for auto consisted of three roadways (Table A 5.3).

Similarly, access segment travel times was similar between auto commuters (27.06 minutes) and transit commuters (30.9 minutes) (Table A 5.3).

Table A 5.3 Results for the Park Lane-Dallas Corridor

	Automobile	Light Rail
	Total Travel Time	
Mean	46.5	52.4
Standard Deviation	7.06	4.28
	Access Segment Travel Time	
Mean	27.1	30.9
Standard Deviation	7.7	4.7
	Common Segment Travel Time	
Mean	19.4	21.47
Standard Deviation	4.7	3.18
Sample Size	30	30

Table A 5.4 Comparison of AM and PM Trip Times by Modes

	Auto	Metro Rail
Inbound AM Average Trip Time	48.1	53.1
Outbound PM Average Trip Time	44.0	51.4

Table A 5.5 Statistical Testing of Convergence Hypothesis

Difference in Mean Travel Times by Mode: (Auto- Metro Rail minutes)		5.87
Standard Error of the Difference of the Means (minutes):		1.51
Hypothesis: “The difference between the mean travel times by modes is at most...”	Significant at the 0.10 Level (90% Confidence)	Significant at the 0.05 Level (95% Confidence)
6 Minutes	NO	NO
7 Minutes	NO	NO
8 Minutes	NO	NO
9 Minutes	YES	YES
10 Minutes	YES	YES

The results in Table A 5.5 indicate that light rail in the defined corridor has drawn door-to-door travel times by highway and light rail to within 9 minutes of one another during congested roadway conditions (with 95 percent statistical confidence).

Although an inter-modal travel time convergence of 9 minutes is sufficient to yield delay savings to highway users (as compared to the "without rail" case – see below), full convergence would of course yield even greater savings

The Mogridge-Lewis framework predicts that non-time related roadway travel costs (i.e, the non-time elements of "generalized cost" such as parking costs, fuel costs and so on) account for the "9 minute wedge." Light rail users are expected to re-explore the roadway option to the point at which the value of non-time generalized cost factors just equals the value of the travel time advantage offered by road. If non-time costs are moderate to high, travel time convergence will occur at a non-zero time differential between road and rail

Methodology Application on Park Lane - Dallas Corridor

Data HLB obtained traffic volume data (HPMS data) from the City of Dallas, Transportation Planning Department. The ridership data were obtained from the Dallas Area Rapid Transit. In addition, door-to-door travel time survey was conducted to derive the degree of convergence in the corridor.

Model The traffic volume and travel time data were used to populate the model. Equation 1 is estimated as follows:

$$\mathbf{T_{a1} = (40 - 20) / (1 + e^{-(-4.255 + 3.983\ E\text{-}05\ (V))}) + 20} \qquad \mathbf{(1)}$$

When V is equal to 0, the travel time is equal the travel time at free flow speed (20 minutes). For an auto traffic volume of 122,600 between Park Lane and Downtown Dallas (based on 1998 O-D tables), the travel time is equal to 35 minutes.

Similarly, Equation 2 is estimated based on auto travel volume, transit ridership data, and convergence level estimate from the survey.

$$\mathbf{T_{a2} = 40 * (1 + 7.2178E\text{-}09\ (V^*)^{1.58})} \qquad \mathbf{(2)}$$

The auto traffic volume in the absence of transit is determined by adding the auto volume in the presence of transit to the generated auto trips by transit riders. The generated is based on:

About 40% of person transit trips will be forgone (determined by the corridor convergence level).

The average vehicle occupancy (HOV and non-HOV) is 1.2 for cars and 40 for buses.

Car trips will make about 90% of trips.

Benefit Estimation To estimate the travel time saving (TTS) attributed to transit, the current traffic volume is inserted into Equation 1 and 2. An auto volume of 144,500 results into:

$$\mathbf{T_{a1} = 36.35,\ T_{a2} = 40.25,\ and\ .\ TTS = T_{a2} - T_{a1} = 3.54}$$

That is on average, on Park Lane-Dallas corridor, transit saves about 4 minutes per auto trip (18 seconds per mile) during the peak period. Once the average travel time saving per vehicle is estimated, the savings are weighted to reflect the congestion level at each time of the day.

Feeding the volume levels for 1999, for the Park Lane-Dallas corridor into equation (1) and (2), HLB estimated the hours of delay saved due to transit for 1999. The estimated hours of delay savings due to transit are an aggregation of three different user savings: savings by light rail riders (market benefits), savings by US-75 common segment users (club benefits), and savings by users of parallel highways (spillover benefits).

The market benefits are estimated based on delay saved (which depends on the distance traveled) by each rail rider within the common segment (Table A 5.6). The club benefits are estimated based on the volume on the common segment using origin-destination table and the daily trip distribution (

Table A 5.7). The spillover benefits are estimated based on the savings per mile, traffic volume, and the distance traveled on segments parallel to the common segment (Table A 5.8). The magnitude of savings by the commuters on these highways decreases with the distance to the common segment.

Table A 5.9 shows the summary of benefits by category. The results indicate that the delay saving due to transit is about 3.54 minutes per trip one way (about 18 seconds per mile). Using a travel time value of $15 per hour and an average of 250 working days per year, the yearly delay saving can be valued at $36.9 million in 1999, this can be translated into a $ 2.8 million per rail mile in the Park Lane-Dallas Corridor. The summary table shows that 44% of the savings are light rail riders savings. These results illustrate the relative high ridership and the high reliability of the light rail in the corridor.

Table A 5.6 Market Benefits for Park Lane-Dallas Corridor

Station	In-bound Trips	Out-bound Trips	Daily Savings (hours)
Park Lane	109727	0	1,283.81
Lovers Lane	30419	6406	333.01
Mockingbird	28320	6139	326.45
Pearl	27577	20062	371.58
St. Paul	21528	23067	351.84
Akard	42068	47874	731.74
West End	85466	58527	913.02
Total	345,105	162,075	4,311

Table A 5.7 Club Benefits for Park Lane-Dallas Corridor

	Distance (miles)	Avg Daily Traffic Volume	Daily Savings (hours)
Common Segment			
US 75	4	158,000	1,232
Knox Street	1	19,546	61
Cole Street/McKinney	5	12,045	211
Access Segment (on average)	3	41,500	486
Total	13		1,990

Table A 5.8 Spillover Benefits for Park Lane-Dallas Corridor

Highways in the corridor	Distance (miles)	Avg Daily Traffic Volume	W	Daily Savings (hours)
US 75	5	126,000	0.8	1,965.60
Hillcrest	6	6,997	0.6	98.24
Boedecker	4	6,158	0.8	76.85
Cole/McKinney	8	11,683	0.91	331.70
Preston	4	9,934	0.4	61.99
Bryan	3	8,205	0.8	76.80
Woodall Rodgers Freeway	6	15,156	0.5	177.33
Northwest	1	52,440	0.6	122.71
Park Lane	1	16,790	0.6	39.29
Akard	1	12,668	0.6	29.64
Pacific	1	14,500	0.8	45.24
Ross	4	7,525	0.6	70.43
San Jacinto	4	7,580	0.7	82.77
Greenville	5	24,183	0.75	353.68
Total				3,532.27

Table A 5.9 Benefits Summary

Benefit Category	Daily Savings In Hours	Daily Savings In Dollars	Yearly Savings In Dollars
Market	4,311	$ 64,672	$ 16,167,962
Club	1,990	$ 29,855	$ 7,463,708
Spillover	3,532	$ 52,984	$ 13,246,016
Total	9,834	$ 147,511	$ 36,877,686

The methodology implies that in the absence of major infrastructure improvements or strong growth in volume of traffic the performance metric will remain stable. So, it should suffice to gather corridor travel time—degree of convergence—once every several years. In the case of major infrastructure improvement or a change in the transit service, however, door to door travel time data should be collected to estimate an accurate performance metric.

Annex A 5.1 Views of the Park Lane Light Rail Corridor Serving Dallas

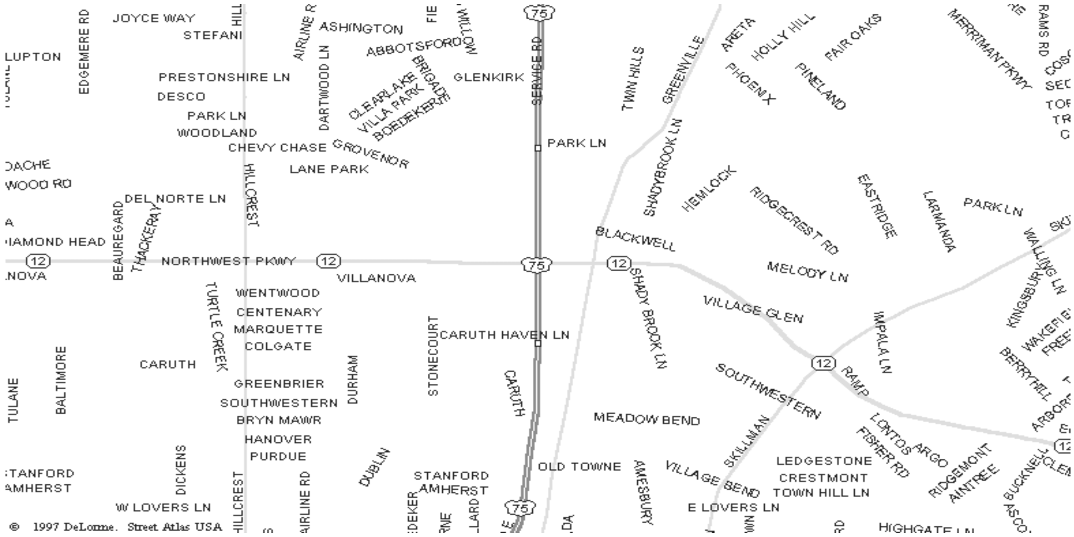


Figure A 5.4 Map of the Residential Area Around Park Lane

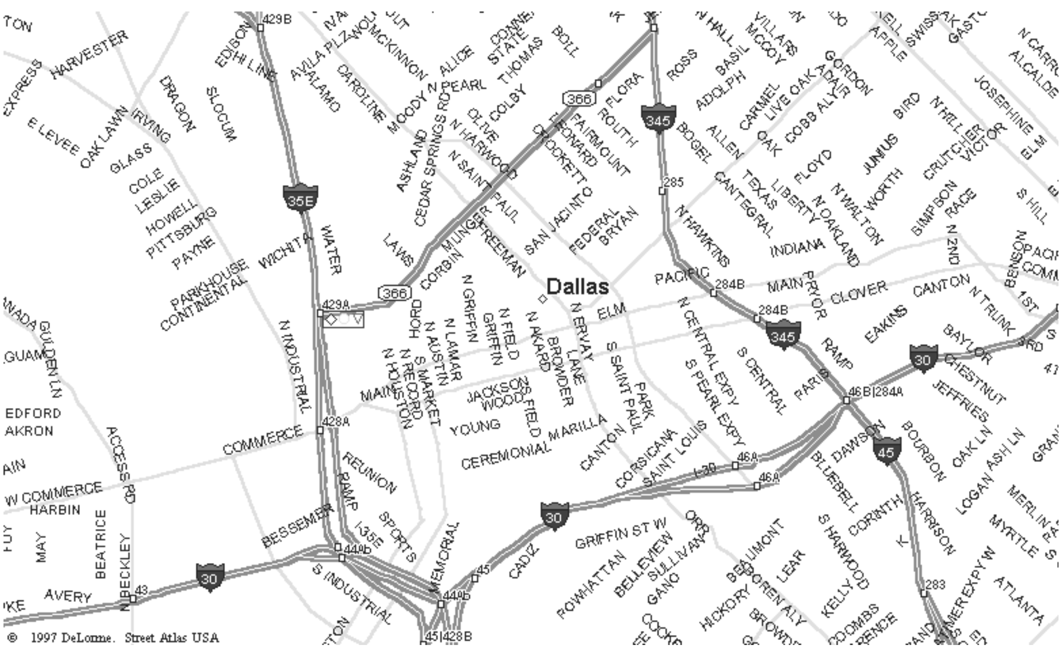
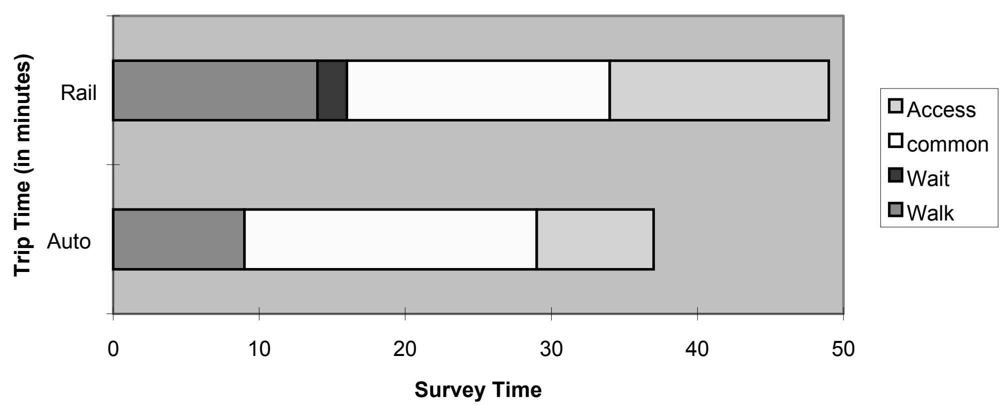


Figure A 5.5 Map of the Central Business District

Annex A 5.2 The survey findings by route

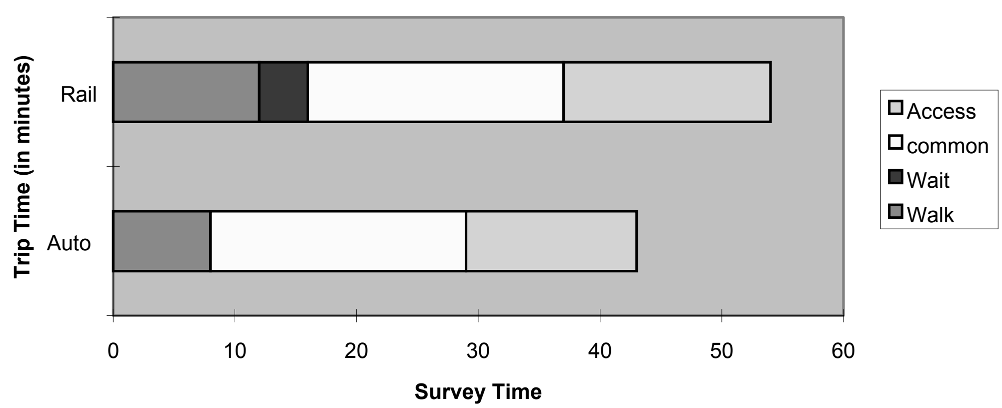
CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE A1:
Deloache & Edgemere - McKinney & N. Lamar

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	37	49
In Common Segment	20	18
Outside Common Segment	8	15
Wait Time	0	2
Walk Time	9	14
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	21.1	15.9
In Common Segment	25.5	33.3
Outside Common Segment	33.8	12.0

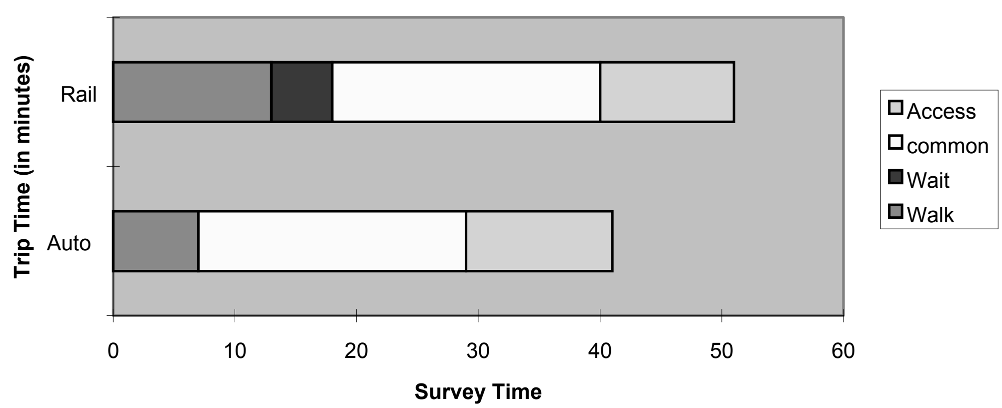


CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE A12:
Deloache & Edgemere - Elm & S. Record

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	43	54
In Common Segment	21	21
Outside Common Segment	14	17
Wait Time	0	4
Walk Time	8	12
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	18.1	14.4
In Common Segment	24.3	28.6
Outside Common Segment	19.3	10.6

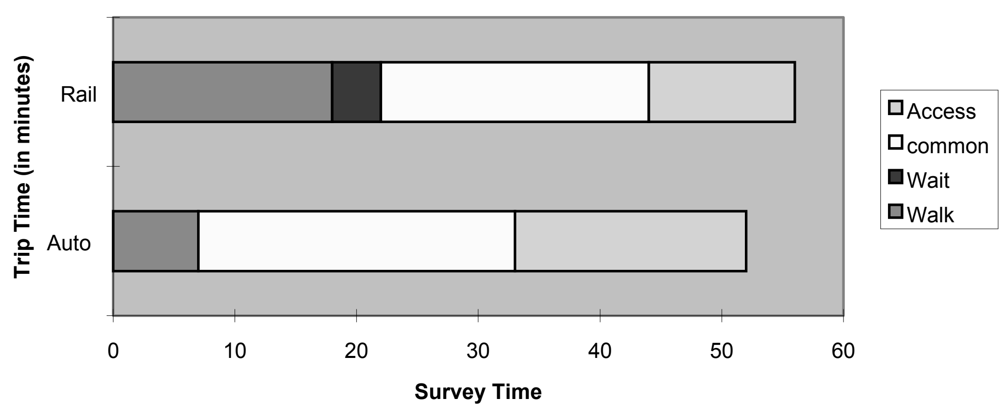


CORRIDOR: Park Lane - Dallas SUMMARY TABLE FOR ROUTE B2: Wentwood & Thackery - McKinney & N. Griffin	SURVEY TYPE	
TIME (minutes)	Auto	Light Rail
Trip	41	51
In Common Segment	22	22
Outside Common Segment	12	11
Wait Time	0	5
Walk Time	7	13
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	19.0	15.3
In Common Segment	23.2	27.3
Outside Common Segment	22.5	16.4



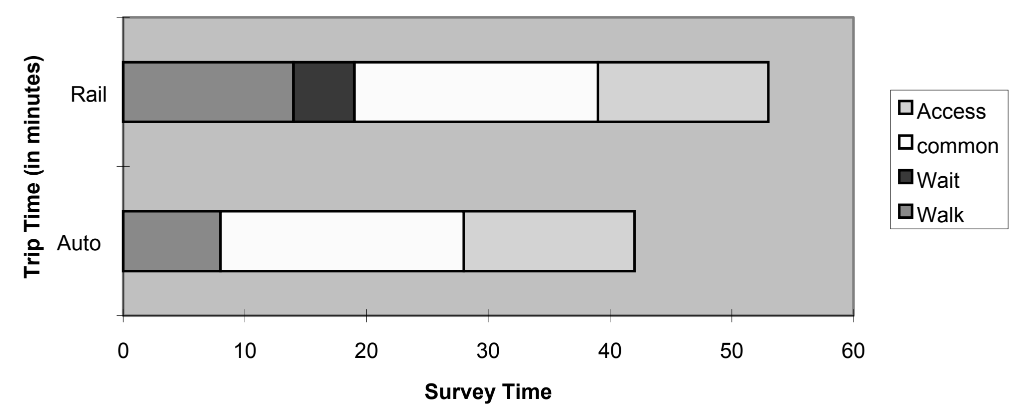
CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE B13:
Wentwood & Thackery - Corbin & S. Record

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	52	56
In Common Segment	26	22
Outside Common Segment	19	12
Wait Time	0	4
Walk Time	7	18
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	15.0	13.9
In Common Segment	19.6	27.3
Outside Common Segment	14.2	15.0

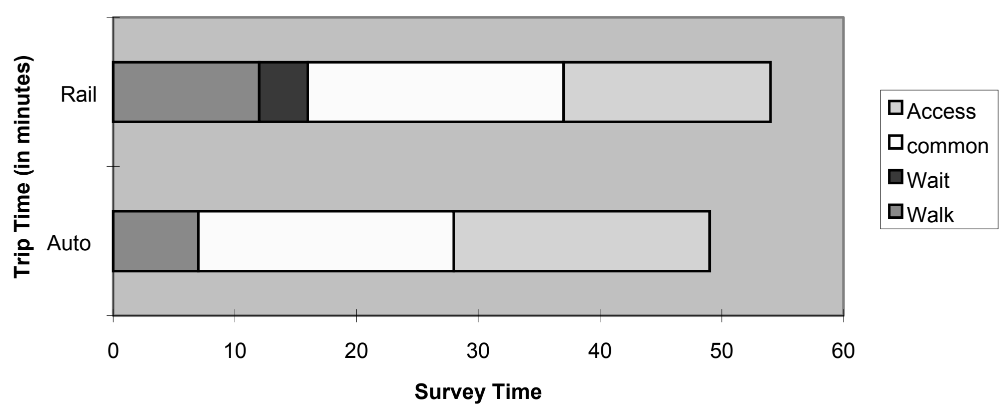


CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE C1:
Douglas & Luther - McKinney & N. Lamar

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	42	53
In Common Segment	20	20
Outside Common Segment	14	14
Wait Time	0	5
Walk Time	8	14
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	18.6	14.7
In Common Segment	25.5	30.0
Outside Common Segment	19.3	12.9

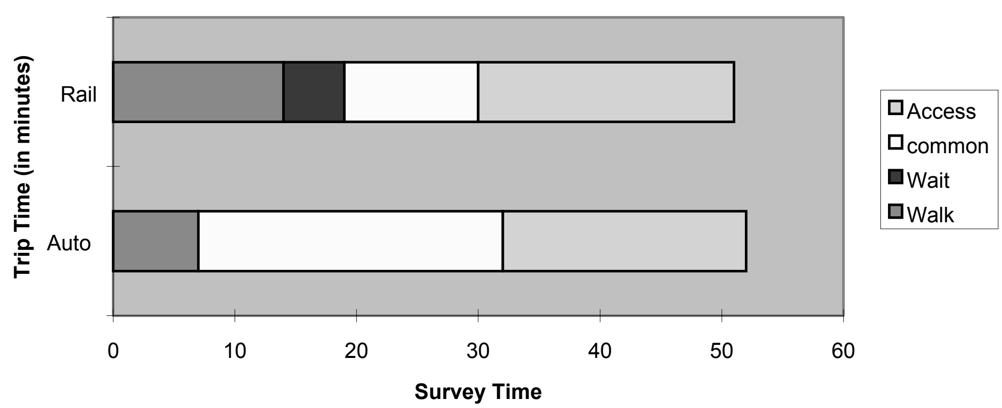


CORRIDOR: Park Lane - Dallas SUMMARY TABLE FOR ROUTE C3: Douglas & Luther - Corbin & N. Griffin	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	49	54
In Common Segment	21	21
Outside Common Segment	21	17
Wait Time	0	4
Walk Time	7	12
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	15.9	14.4
In Common Segment	24.3	28.6
Outside Common Segment	12.9	10.6



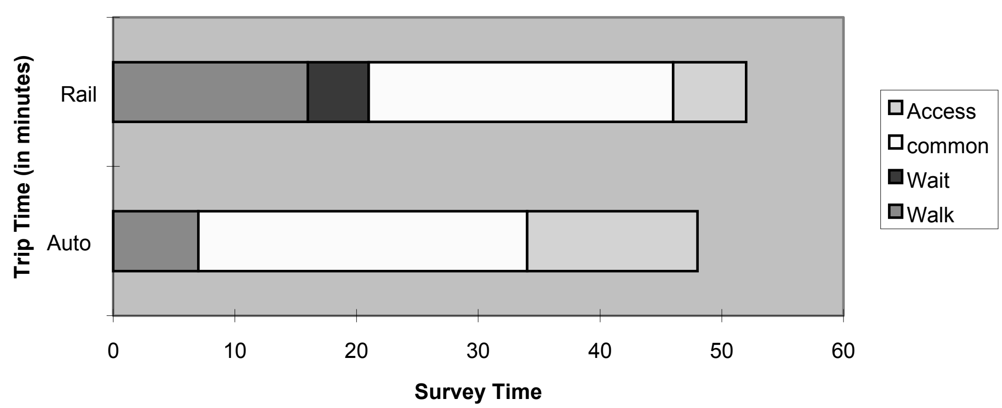
CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE D2:
Park Lane & Dougkas - McKinney & N. Griffin

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	52	51
In Common Segment	25	11
Outside Common Segment	20	21
Wait Time	0	5
Walk Time	7	14
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	15.0	15.3
In Common Segment	20.4	54.5
Outside Common Segment	13.5	8.6



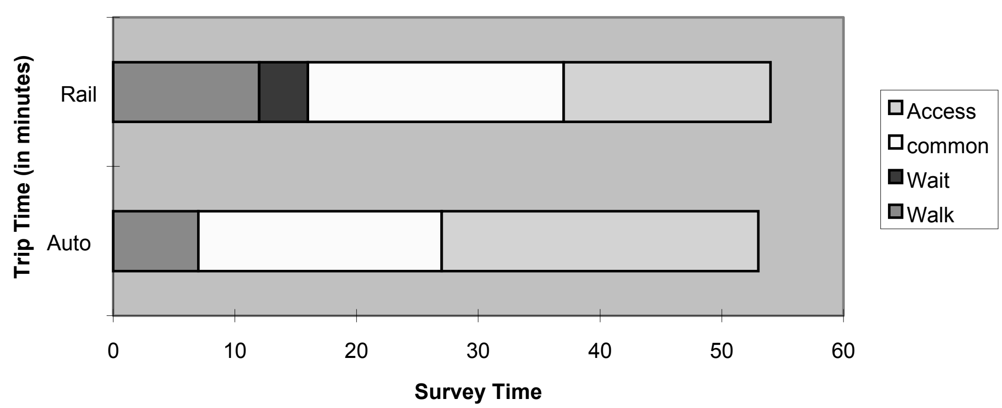
CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE D4:
Park Lane & Dougkas - Ross & Freeman

	SURVEY TYPE	
TIME (minutes)	Auto	Light Rail
Trip	48	52
In Common Segment	27	25
Outside Common Segment	14	6
Wait Time	0	5
Walk Time	7	16
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	16.3	15.0
In Common Segment	18.9	24.0
Outside Common Segment	19.3	30.0



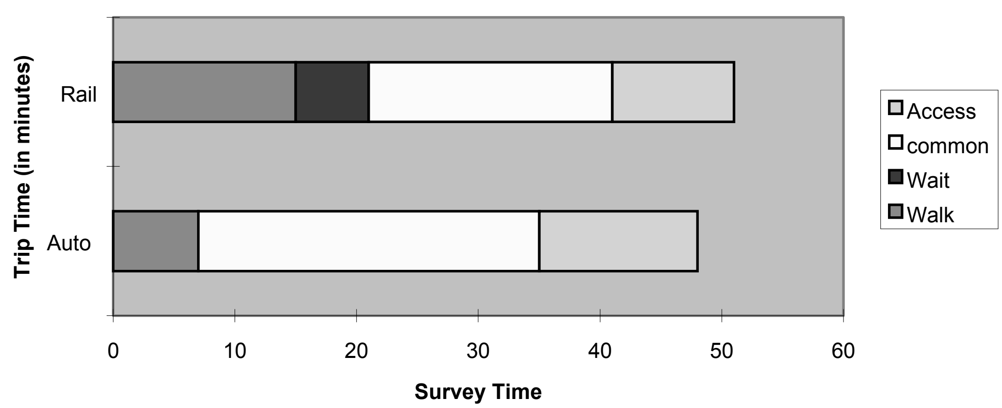
CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE E2:
Aberdeen & Tibbs - McKinney & N. Griffin

	SURVEY TYPE	
TIME (minutes)	Auto	Light Rail
Trip	53	54
In Common Segment	20	21
Outside Common Segment	26	17
Wait Time	0	4
Walk Time	7	12
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	14.7	14.4
In Common Segment	25.5	28.6
Outside Common Segment	10.4	10.6



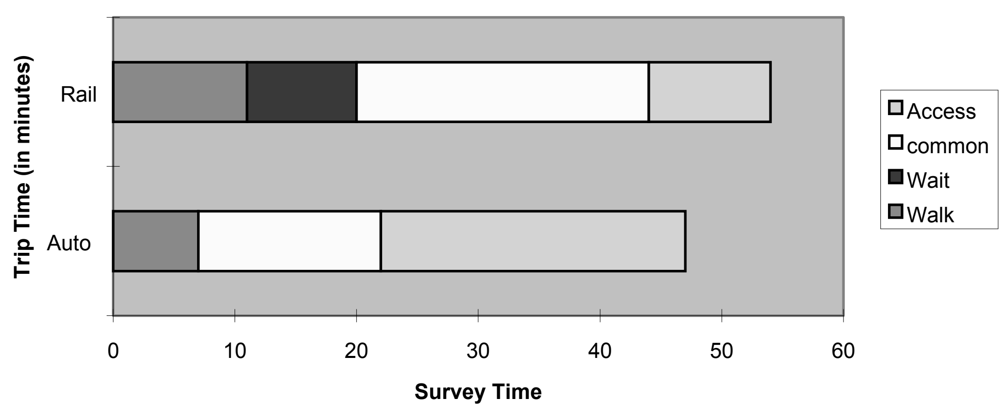
CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE E5:
Aberdeen & Tibbs - San Jacinto & N. Akard

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	48	51
In Common Segment	28	20
Outside Common Segment	13	10
Wait Time	0	6
Walk Time	7	15
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	16.3	15.3
In Common Segment	18.2	30.0
Outside Common Segment	20.8	18.0

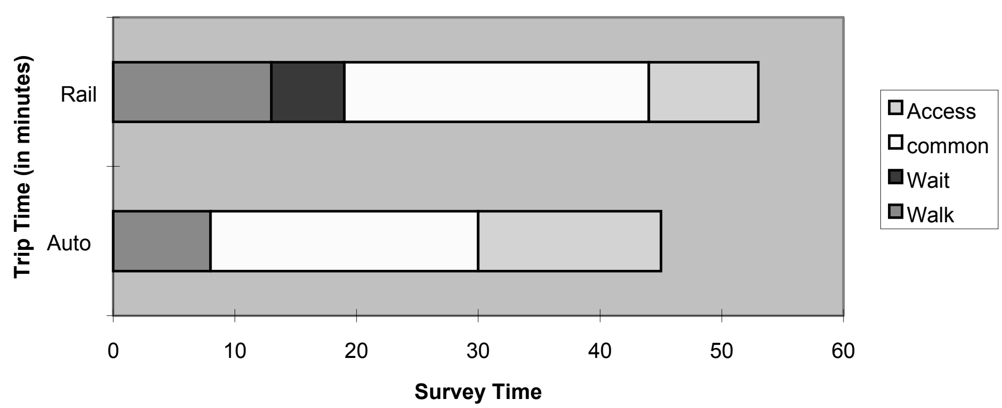


CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE F6:
Thackery & Norway - Bullington & Bryan

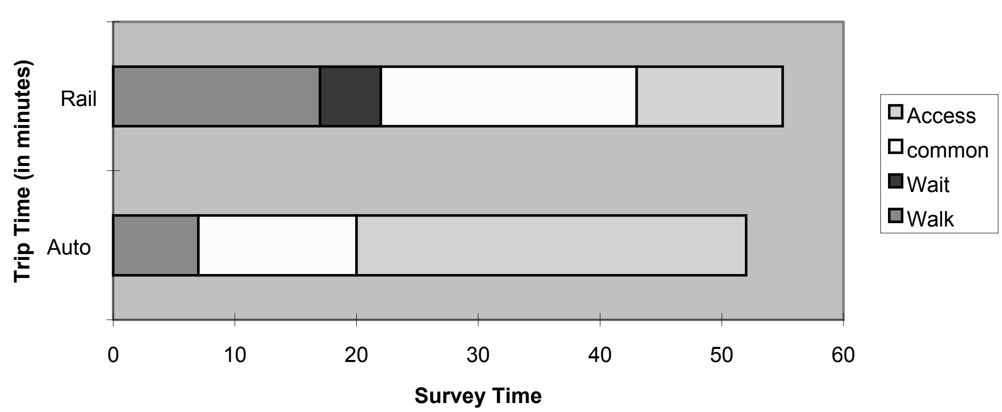
	SURVEY TYPE	
TIME (minutes)	Auto	Light Rail
Trip	47	54
In Common Segment	15	24
Outside Common Segment	25	10
Wait Time	0	9
Walk Time	7	11
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	16.6	14.4
In Common Segment	34.0	25.0
Outside Common Segment	10.8	18.0



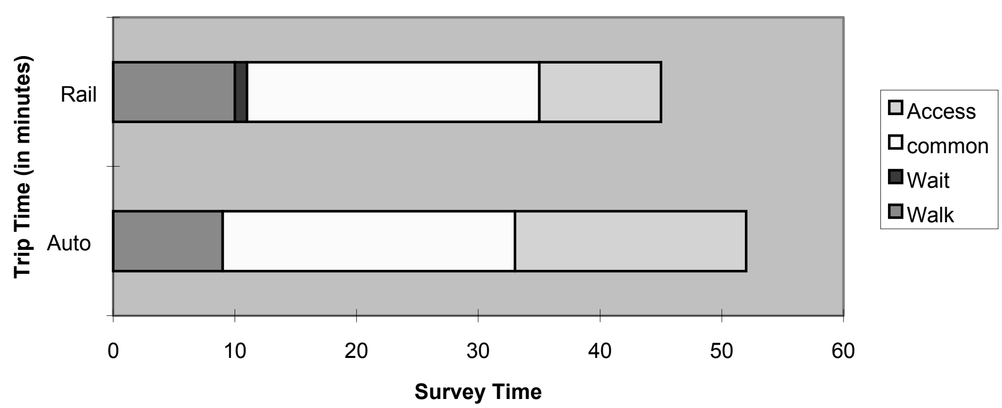
CORRIDOR: Park Lane - Dallas SUMMARY TABLE FOR ROUTE G7: Bodeker & Lakehurst - Elm & Stone		
	SURVEY TYPE	
TIME (minutes)	Auto	Light Rail
Trip	45	53
In Common Segment	22	25
Outside Common Segment	15	9
Wait Time	0	6
Walk Time	8	13
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	17.3	14.7
In Common Segment	23.2	24.0
Outside Common Segment	18.0	20.0



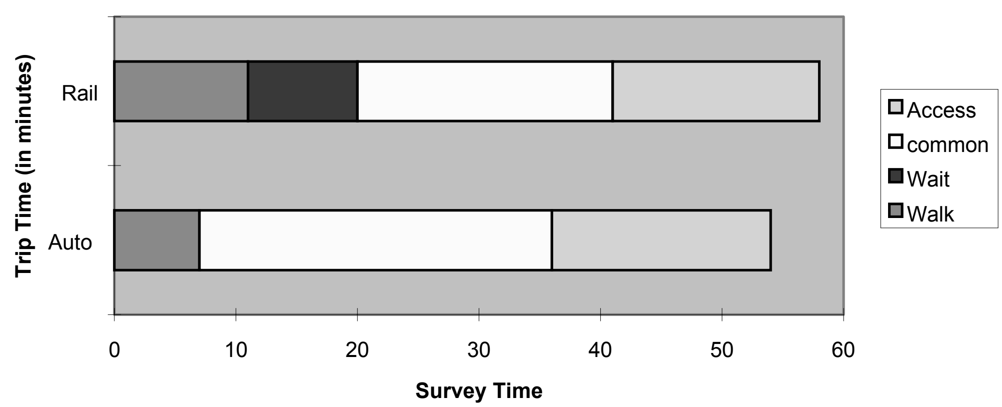
CORRIDOR: Park Lane - Dallas SUMMARY TABLE FOR ROUTE I9: Kingsley & Fieldcrest - Wood & S. Field	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	52	55
In Common Segment	13	21
Outside Common Segment	32	12
Wait Time	0	5
Walk Time	7	17
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	15.0	14.2
In Common Segment	39.2	28.6
Outside Common Segment	8.4	15.0



CORRIDOR: Park Lane - Dallas SUMMARY TABLE FOR ROUTE J10: Wild Valley & Larmanda - Wood & S. Lamar	SURVEY TYPE	
TIME (minutes)	Auto	Light Rail
Trip	52	45
In Common Segment	24	24
Outside Common Segment	19	10
Wait Time	0	1
Walk Time	9	10
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	15.0	17.3
In Common Segment	21.3	25.0
Outside Common Segment	14.2	18.0

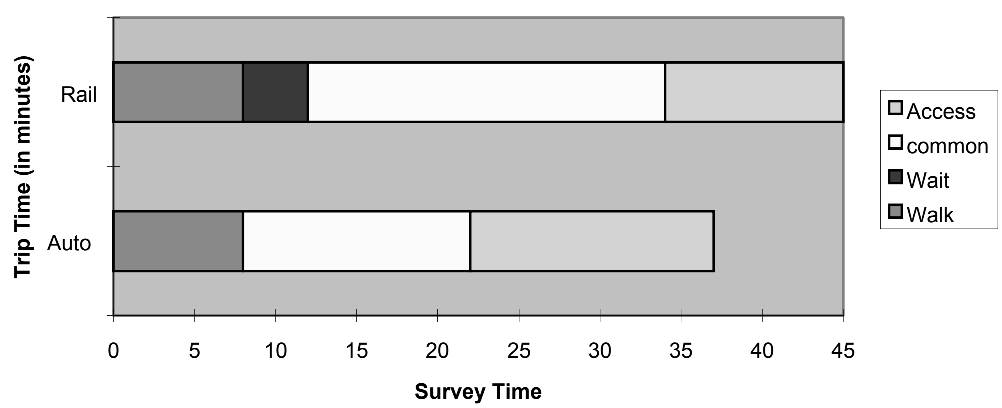


CORRIDOR: Park Lane - Dallas SUMMARY TABLE FOR ROUTE K11: Berryhill & Town North - Commerce & S. Record	SURVEY TYPE	
TIME (minutes)	Auto	Light Rail
Trip	54	58
In Common Segment	29	21
Outside Common Segment	18	17
Wait Time	0	9
Walk Time	7	11
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	14.4	13.4
In Common Segment	17.6	28.6
Outside Common Segment	15.0	10.6



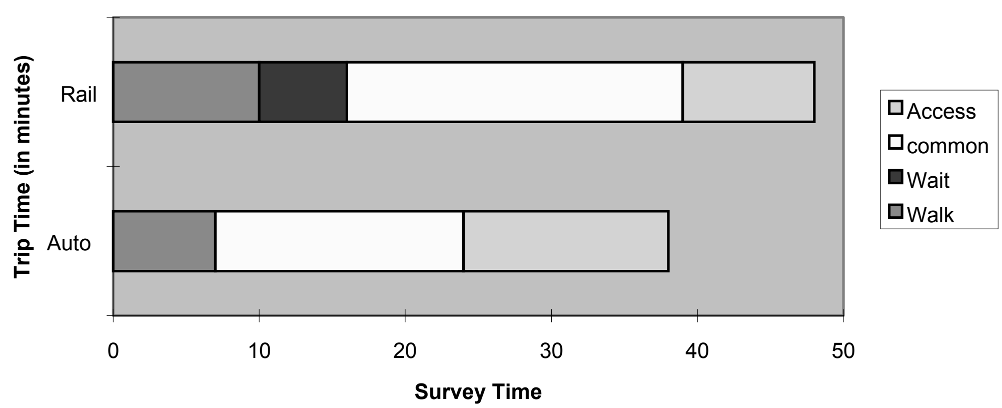
CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE 1B:
McKinney & N. Lamar - Westwood & Thackery

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	37	45
In Common Segment	14	22
Outside Common Segment	15	11
Wait Time	0	4
Walk Time	8	8
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	21.1	17.3
In Common Segment	36.4	27.3
Outside Common Segment	18.0	16.4



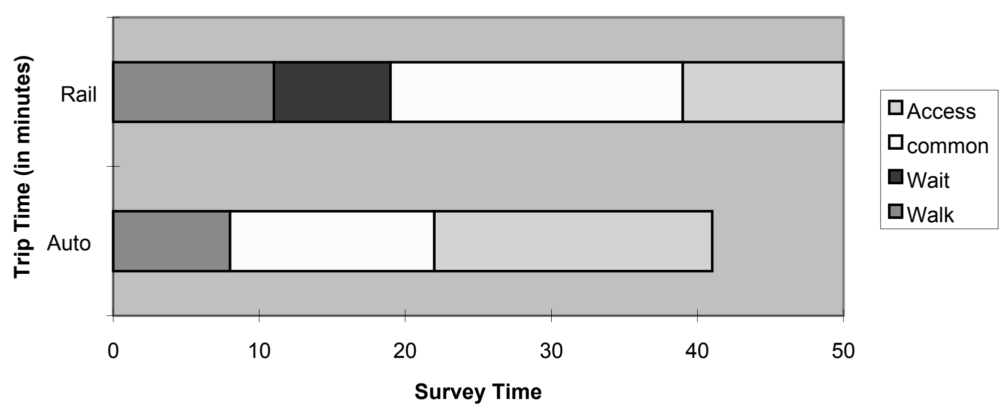
CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE 1D:
McKinney & N. Lamar - Park Lane & Douglas

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	38	48
In Common Segment	17	23
Outside Common Segment	14	9
Wait Time	0	6
Walk Time	7	10
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	20.5	16.3
In Common Segment	30.0	26.1
Outside Common Segment	19.3	20.0



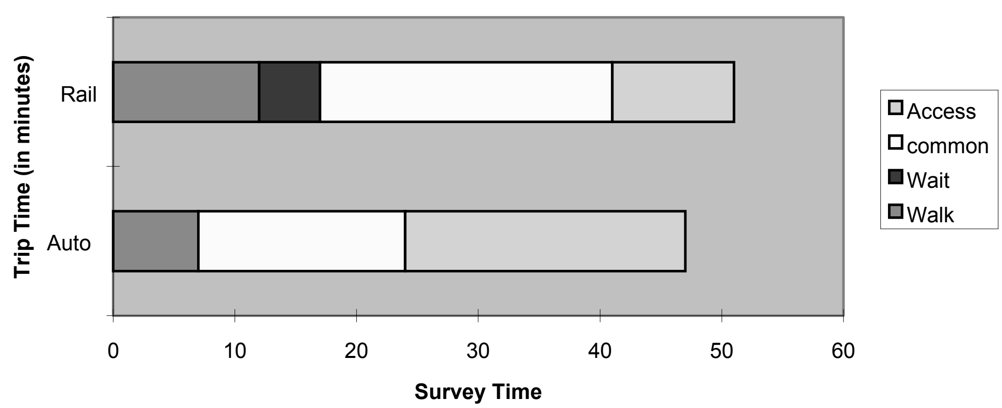
CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE 2C
McKinney & N. Griffin - Douglas & Luther

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	41	50
In Common Segment	14	20
Outside Common Segment	19	11
Wait Time	0	8
Walk Time	8	11
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	19.0	15.6
In Common Segment	36.4	30.0
Outside Common Segment	14.2	16.4



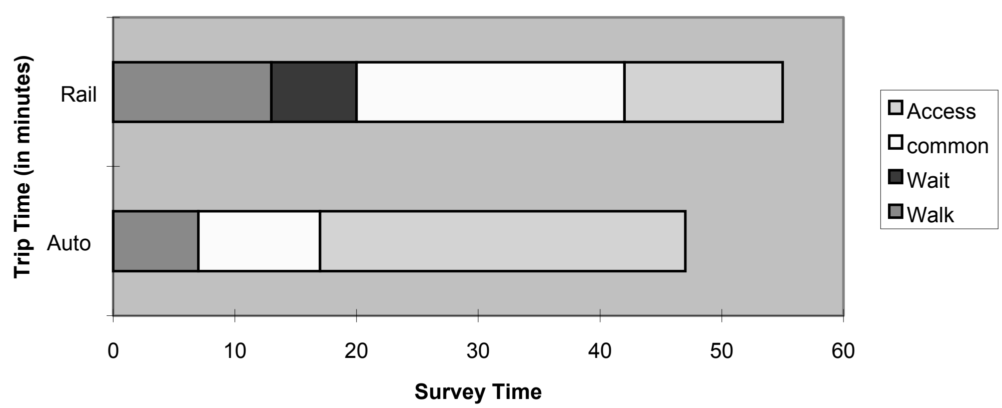
CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE 2E
McKinney & N. Griffin -Aberdeen & Tibbs

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	47	51
In Common Segment	17	24
Outside Common Segment	23	10
Wait Time	0	5
Walk Time	7	12
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	16.6	15.3
In Common Segment	30.0	25.0
Outside Common Segment	11.7	18.0



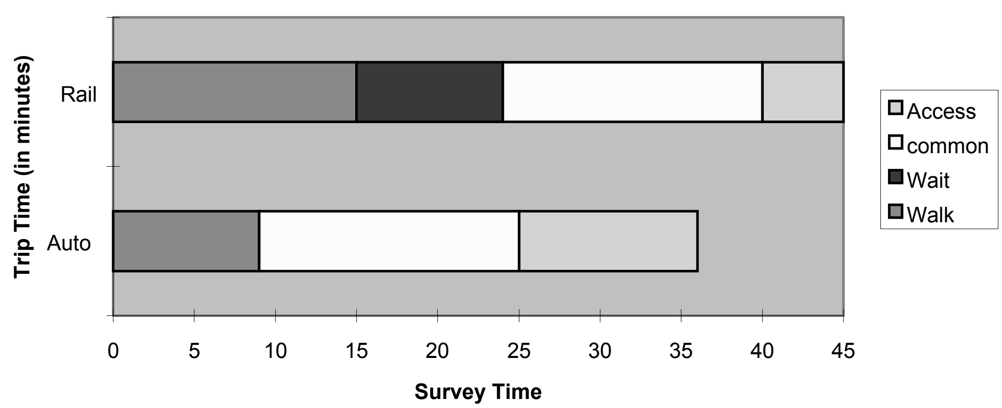
CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE 3D
Corbin & N. Griffin - Park Lane & Douglas

	SURVEY TYPE	
TIME (minutes)	Auto	Light Rail
Trip	47	55
In Common Segment	10	22
Outside Common Segment	30	13
Wait Time	0	7
Walk Time	7	13
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	16.6	14.2
In Common Segment	51.0	27.3
Outside Common Segment	9.0	13.8

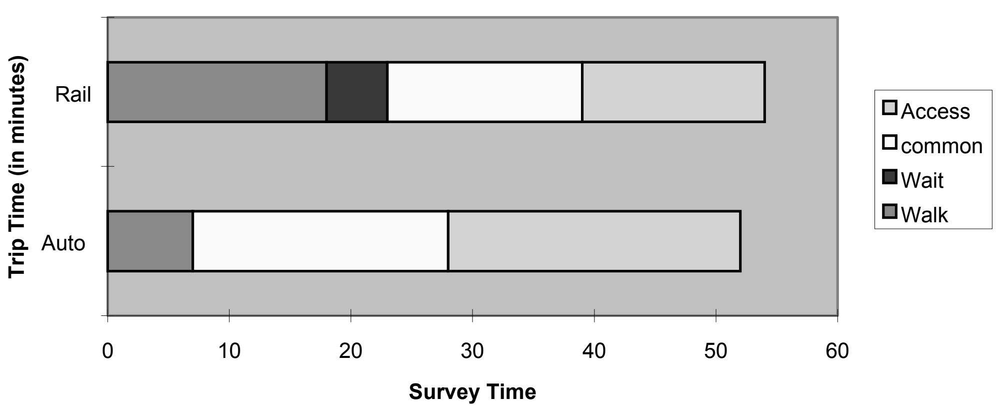


CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE 4E
Ross & Freeman - Aberdeen & Tibbs

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	36	45
In Common Segment	16	16
Outside Common Segment	11	5
Wait Time	0	9
Walk Time	9	15
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	21.7	17.3
In Common Segment	31.9	37.5
Outside Common Segment	24.5	36.0

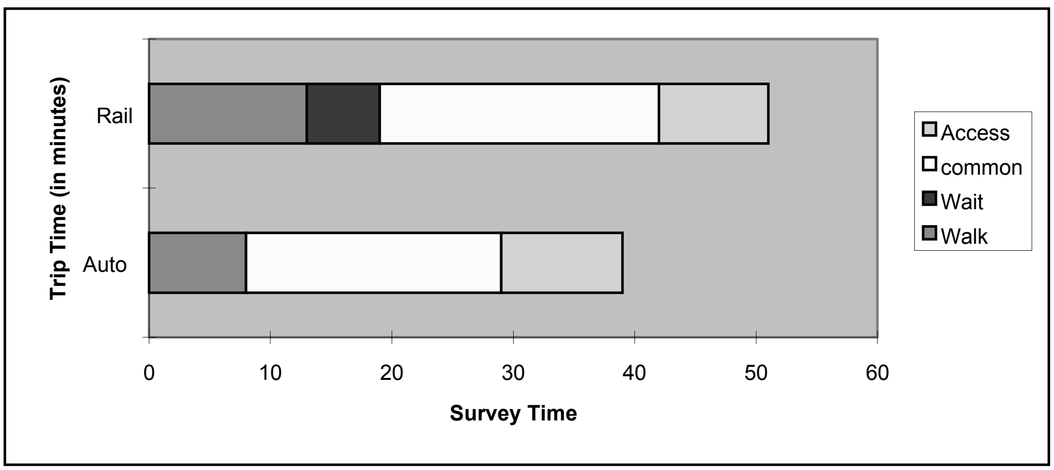


CORRIDOR: Park Lane - Dallas SUMMARY TABLE FOR ROUTE 5F San Jacinto & N. Akard - Thackery & Norway	SURVEY TYPE	
TIME (minutes)	Auto	Light Rail
Trip	52	54
In Common Segment	21	16
Outside Common Segment	24	15
Wait Time	0	5
Walk Time	7	18
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	15.0	14.4
In Common Segment	24.3	37.5
Outside Common Segment	11.3	12.0



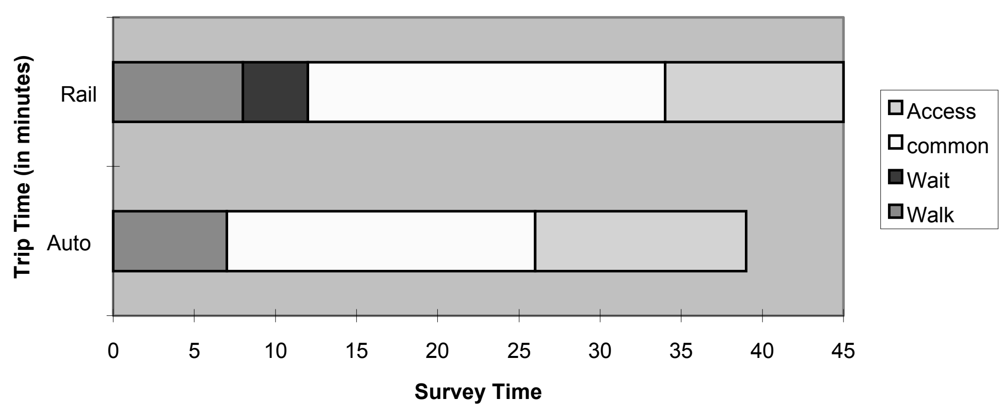
CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE 6G
Bullington & Bryan - Bordeker & Lakehurst

	SURVEY TYPE	
TIME (minutes)	Auto	Light Rail
Trip	39	51
In Common Segment	21	23
Outside Common Segment	10	9
Wait Time	0	6
Walk Time	8	13
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	20.0	15.3
In Common Segment	24.3	26.1
Outside Common Segment	27.0	20.0

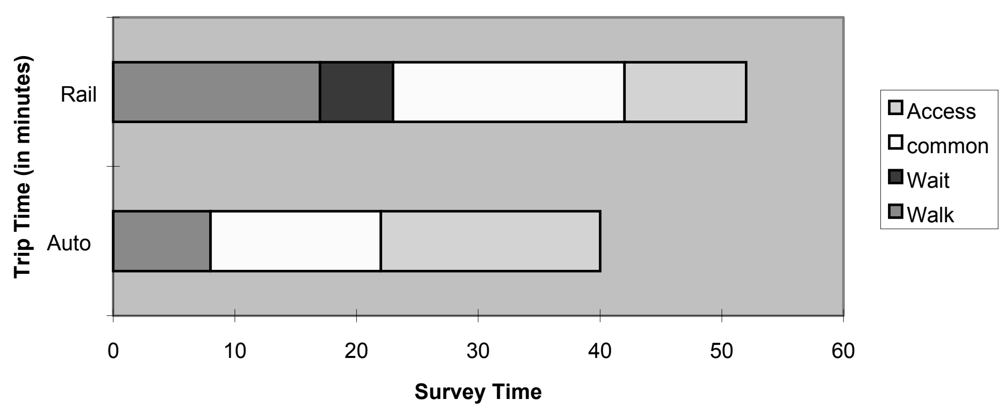


CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE 7H
Elm & Stone - Church & Arborgate

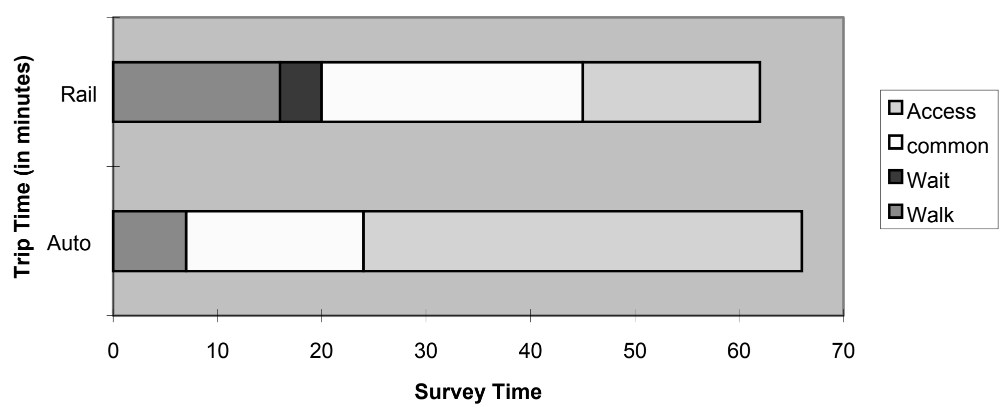
	SURVEY TYPE	
TIME (minutes)	Auto	Light Rail
Trip	39	45
In Common Segment	19	22
Outside Common Segment	13	11
Wait Time	0	4
Walk Time	7	8
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	20.0	17.3
In Common Segment	26.8	27.3
Outside Common Segment	20.8	16.4



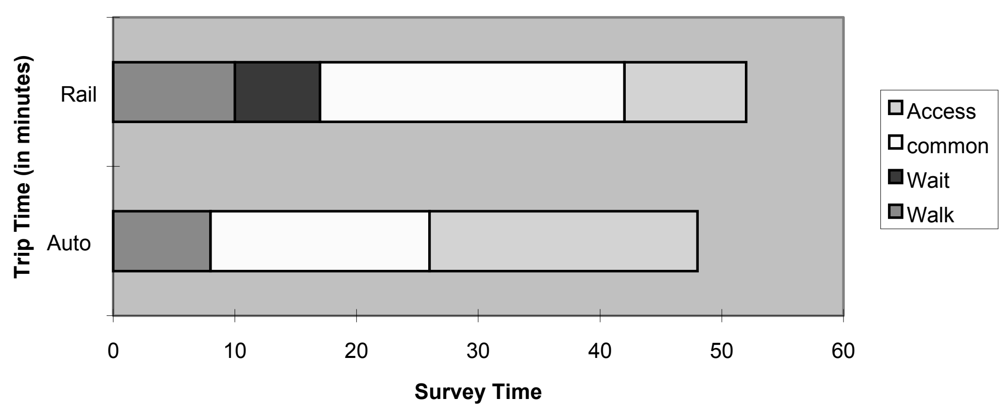
CORRIDOR: Park Lane - Dallas SUMMARY TABLE FOR ROUTE 8I Commerce & S. Akard - Kingsley & Fieldcrest	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	40	52
In Common Segment	14	19
Outside Common Segment	18	10
Wait Time	0	6
Walk Time	8	17
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	19.5	15.0
In Common Segment	36.4	31.6
Outside Common Segment	15.0	18.0



CORRIDOR: Park Lane - Dallas SUMMARY TABLE FOR ROUTE 9J Wood & S. Field - Wild Valley & Larmanda	SURVEY TYPE	
TIME (minutes)	Auto	Light Rail
Trip	66	62
In Common Segment	17	25
Outside Common Segment	42	17
Wait Time	0	4
Walk Time	7	16
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	11.8	12.6
In Common Segment	30.0	24.0
Outside Common Segment	6.4	10.6

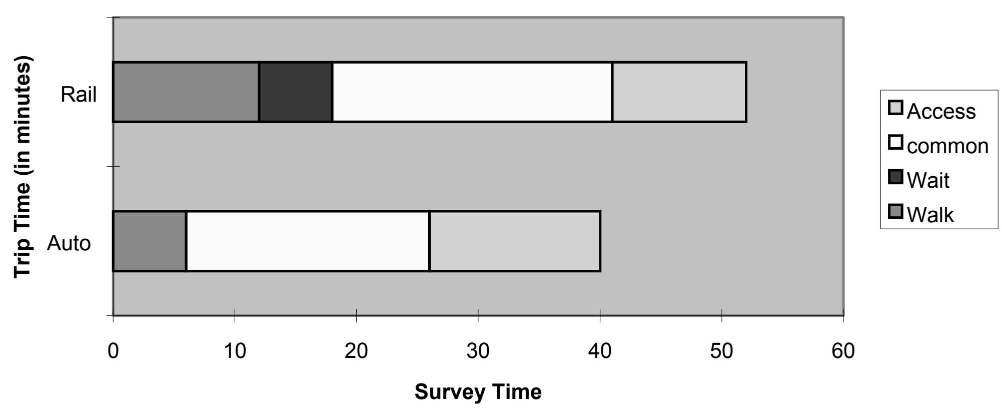


CORRIDOR: Park Lane - Dallas SUMMARY TABLE FOR ROUTE 10K Wood & S. Lamar - Berryhill & Town North	SURVEY TYPE	
TIME (minutes)	Auto	Light Rail
Trip	48	52
In Common Segment	18	25
Outside Common Segment	22	10
Wait Time	0	7
Walk Time	8	10
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	16.3	15.0
In Common Segment	28.3	24.0
Outside Common Segment	12.3	18.0



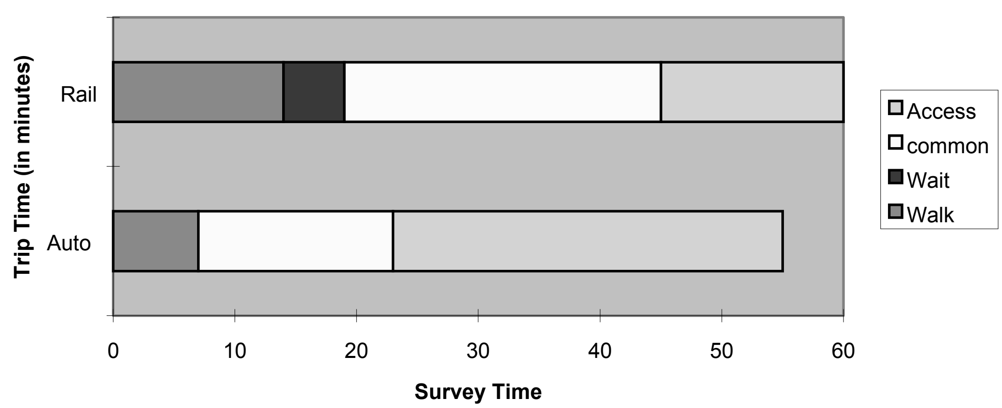
CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE 11A:
Commerce & S. Record - Deloache & Edgemere

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	40	52
In Common Segment	20	23
Outside Common Segment	14	11
Wait Time	0	6
Walk Time	6	12
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	19.5	15.0
In Common Segment	25.5	26.1
Outside Common Segment	19.3	16.4



CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE 12B:
Elm & S. Record - Westwood & Thackery

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	55	60
In Common Segment	16	26
Outside Common Segment	32	15
Wait Time	0	5
Walk Time	7	14
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	14.2	13.0
In Common Segment	31.9	23.1
Outside Common Segment	8.4	12.0



CORRIDOR: Park Lane - Dallas
SUMMARY TABLE FOR
ROUTE 13C:
Corbin & S. Record - Douglas & Luther

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	35	49
In Common Segment	13	20
Outside Common Segment	15	11
Wait Time	0	9
Walk Time	7	9
DISTANCE (miles)		
Route Distance	13.0	13.0
Common Segment Distance	8.5	10.0
SPEED (mph)		
Trip	22.3	15.9
In Common Segment	39.2	30.0
Outside Common Segment	18.0	16.4